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DIAGNOSIS FOR EARLY DETECTION OF SYMPTOMS OF WHITE WILTING OF RICE PLANT LEAVES

Tagami Yoshiya et.al.

Nogyo Gyobi Engei
(Agriculture and
Horticulture) 32: 1523-25,
1957

[Translator's note: Literal translations are given in quotation marks.]

The "white wilting of rice leaves" [Ineshiro hagaraoyo], commonly called hagare is a bacterial disease causing leaf wilt which is one of the chief dangers to warm area rice cultivation in Japan. This disease ~~is not~~ as common as other fungus diseases, has its own peculiar areas of occurrence and manifests a rather local character even in the same warm area. The disease generally has a tendency to break out in paddy fields in low temperature areas near rivers and lakes, especially after flooding or inundation. However, as several varieties of new rice and new methods of fertilizing using large amounts of fertilizer in order to gain large crops become more widespread, the disease no longer is restricted to low temperature spots, but has been observed to break out in valley basins and in hilly areas generally regarded as quite dry. It is unfortunate that with every passing year the disease has been on the rise. In view of the importance of early detection ~~as described below~~ this paper presents a classification of the symptoms of white leaf wilt and describes a simple method of diagnosis to be done in the initial stage of outbreak of the disease. ~~The author will~~ be happy if this paper is of assistance.

1. Hibernation of Pathogenic Bacteria and Importance of Early Detection.

According to recent research, this disease have been observed to break out spontaneously even in grosses other than rice, such as the savanukagusa [a type of grass], water oat and ashikaki ["foot scratcher"] and it has been established that the pathogenic bacteria hibernate by means

of these grasses. According to a study made by the author on May 17, the existence of large amounts of pathogenic bacteria was observed on the epigeal stem, the subterranean stem and the roots of sayanukagusa in its usual growth areas. Diseased leaves were also observed on sayanukagusa transplanted in pots on May 9. It is also apparently possible for damaged straw and seeds which have been stored in a dry state to become primary sources of transmission of the disease. Consequently, as the climate becomes warmer, the pathogenic bacteria gradually increase in these hibernation spots. The area of spoilage increases on account of rainfall and contamination of seedlings is believed possible by transfer of the bacteria in irrigation water in the nursery bed slag. Previously this disease began to break out to the greatest extent after the height of the tillering period in the paddy field period causing damage in the latter part of the rice harvest period. Actually, the disease either breaks out or becomes latent earlier than this. In Kyushu it follows the course described above and usually in the middle of July the first strains of the pathogene appear. It is not unusual to find the first strains appearing two or three weeks after field planting and can sometimes be found even in the nursery beds.

The earlier this disease breaks out the greater is the damage it causes in the fields. According to an investigation by Hisabara (1955), the strains which develop in Kyushu in the last third of July bring considerable harm to ripening rice causing up to a 40% loss in the harvest of unhulled rice. Strains developing in the middle of August cause a 35% loss in harvest. The strains which develop in the first part of September around the earing period cause the next greatest loss after that of July, while outbreak of the disease after the "high temperature season" reportedly cause less damage to the harvest. When this is considered from the stand point of the spread of the bacteria, it is natural that the time of outbreak of the disease throughout the field or in the roots will depend on the degree of contamination with the disease bacteria in the initial stages of cultivation of the rice plant. Minakami and Seki (1954-1955) detected the existence of numerous bacteria in the wash solution from a seemingly healthy leaf around the first part of August in a rice field in which the "white wilting of rice leaves disease" had occurred only to a small degree. Results of research by the authors in 1956 using the bacteriophage method developed by Wakimoto and Yoshii (1954-1956) to study the contamination of irrigation water and rice plants prior to the outbreak of the disease showed that contamination of rice plants is greater, the earlier the disease first breaks out in the field. We wish to emphasize that this means that early detection of contamination or of the first strains of the disease in irrigation water and rice plant roots in the beginning of the cultivation stage is of major importance in controlling the disease.

Existing methods of detection of pathogenic bacteria in rice plants and irrigation water include the concentrated inoculation method of Minakami (1954) and the bacteriophage method of Wakimoto mentioned above. However, both of these pose a problem as laboratory facilities are necessary and

they are not simple methods. It is thus necessary to depend on early detection of the first strains of this disease. However, there are some leaves with similar symptoms, to be described below, and it is difficult to distinguish these from leaves contaminated with the disease unless one is very experienced. For this reason the authors felt that it was of prime importance to distinguish and classify the symptoms for early detection of this disease. They have developed the four types described below together with a simple method for diagnosis in the early stages of the disease and wish to make these available to farmers and personnel engaged in improvement of agriculture.

2. Symptoms of the "White Wilting of Rice Plants"

Takaishi (1909), Ishiyama (1912), Kuwatsuka (1933) and Ikata (1949) have written about the symptoms of this disease.

Table 1: Symptoms of "White Wilting of Rice Plant Disease"

Disease Type:	a. Acute wilting	b. Leaf edge type	c. Striped	d. Spotted
Configuration	Water soaked curled leaf tip, wilting	Serrated	Stripes	Spots
Color	Green-blue Bluish White	Yellow white gray	Pale Yellow yellow gray	Same as in (c)
Position of disease spots	Upper half overall	Leaf edge	Portions except leaf edge	Same as in (c)
Phyllotaxis	Upper leaves	(Not applicable)	(Not applicable)	Center leaf
Period of Development	Nursery height of tiller season	Main paddy field	Middle paddy season	After typhoon

Usually the symptoms of this disease bring to mind yellow or yellowish white disease spots formed along the leaf edges. However, as shown in Table 1 and figure 4, four types of symptoms can be differentiated each with their own peculiarities.

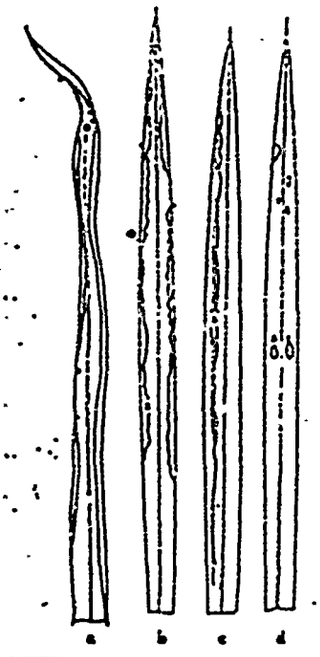

Figure 1: Appearance of leaves afflicted with the "white wilting disease." a. Acute wilting type; b. leaf edge type; c. "tea" type; d. spotted type; o. clumps of mucilage; s. spotted sections.

Of the types listed in the above table, the acute wilting type is apparently not widely known. Prevalent in the initial period of outbreak of the disease are the acute wilting and leaf edge types. In the former, watery green spots rapidly develop; the leaf tips curl, the upper half of the leaf blade, or the entire leaf becomes bluish white and the plant wilts. This is prevalent in seedlings, young leaves and leaves with excess nitrogen, and appears in the nursery and tillering periods. The shape of the leaf edges appears normal throughout the paddy field stage and yellowish shite or grayish white wavy-edged spots appear on one or both sides of the leaf edge. The striped and spotted types do not appear in the beginning stage of rice plant cultivation. The stripe type forms yellowish on grayish white blotches in lines in sections other than the leaf edge, which also appear in injured portions after a typhoon. It is the type most prevalent in the sayanukagusa grass mentioned above. The spotted type consists of pale yellow brown or grayish white spots which appear in injured parts of plants after a typhoon in fields where the disease increases rapidly. It is prevalent in the leaves just below the uppermost part and also appears in the water oat, in which case the disease spots do not develop (to any great extent).

There are many cases in which these diseased leaves exude small granular or starchy lumps of mucilage of the pathogenic bacteria from

injured parts of the leaf edges or leaf surfaces. The formation of lumps of mucilage is most widespread in the acute wilting type of disease (see table one), is of decreasing occurrence in the leaf-edge and striped types and rarely occurs in the spotted type. These lumps of "mucilage" consist of hardened dried bacterial fluid exuded by the pathogenes together with the juice of the rice plant when this fluid increases inside the diseased tissue. They are an orange yellow or dirty yellow color with a diameter of 1 to 2 mm. Several lumps of this mucilage is wrapped inside the curled leaves of plants having the acute wilting pattern of the disease. When enough drops of rainwater are provided. The leaves extend outward and the mucilage is scattered in every direction. This means that the mucilage plays a very important role in secondary infection and the diagnostic method described below was devised with special attention having been given to this mucilage. The bacteria count in one lump of mucilage was over one billion according to analysis by the bacteriophage method.

4. /sic/ Symptoms which are Easily Confused with the "White Wilting of Rice Leaves Disease"

The greatest impediment to the early detection of the disease in its early stages are parasitic or nonparasitic leaves which manifest symptoms very similar to those of the white wilting of rice. During investigation, the authors have often encountered leaves with indications that impeded judgement. They are briefly as follows:

a. Yellowing of aged bottom leaves.

b. Striped yellowed leaves due to rice borer.

c. Yellowed leaves due to application of fertilizer or agricultural chemicals.

d. Leaves which have turned yellow due to other causes.

As mentioned above, there are many yellowed leaves, and there are few (leaves) with symptoms similar to the acute wilting type which are prevalent in the initial stage of the disease.

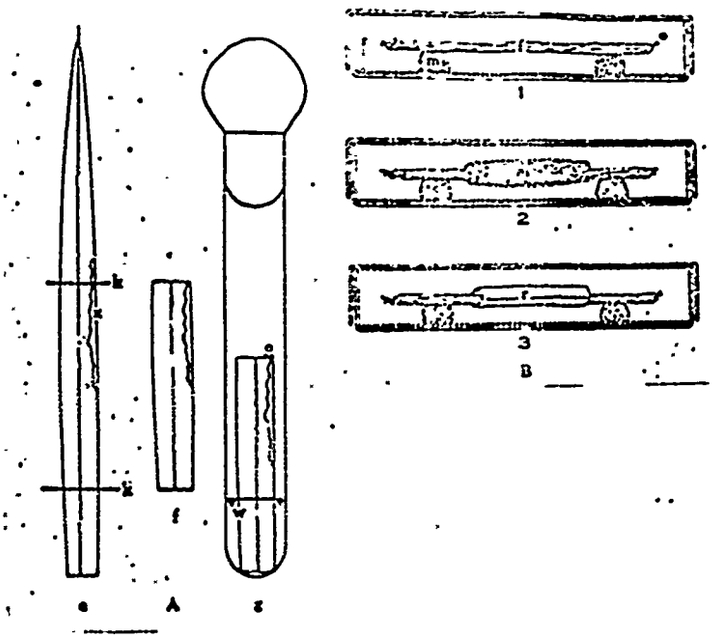

Figure 2: Simple Method of Diagnosis

A

e. Leaf under examination, k. Cut with scissors, f. Leaf cut to appropriate length, g. Leaf in test tube with mucilage produced, o. Mucilage lump, w. Water, x. Abnormal section.

B

1-3
f. Leaf under examination, r. filter paper, m. Absorbent cotton, Filter paper and cotton soaked with water, maintaining moisture inside of sharen /This is a word borrowed from English or some other European language. It is transliterated here./

5. Simple Method for Diagnosis of White Wilting Disease in Early Stage.

The authors have devised the following simple procedure as a comparatively easy and reliable method of diagnosis for the sake of the above reasons and objectives. According to this method, anyone should easily be able to determine whether a suspected plant in the field has leaves which are suffering from the "white wilting disease."

Take by the base a leaf which you wish to diagnose, from leaves showing the symptoms of the disease described above or having similar characteristics. With scissors cut across (or tear) the yellowed abnormal part as shown in Fig. 2A. Discard the end and cut the remainder to an appropriate length (5 to 10 cm). Put the leaf base downwards into a test

tube (flask or beaker) or a covered teacup filled with well or tap water. Replace cover or stopper and set aside for one or two hours inside room. Or, as shown in figure 2B 1-3, use filter paper, absorbent cotton or share adequately moistened with water to make a humidifying chamber and set aside for 15 minutes.

By doing this, if the leaf is actually suffering from "white leaf wilt" globular clumps of muddy white or pale yellow mucilage will emerge in the cut section during the yellowing period as described above. On the other hand, if the leaf is not suffering from "white leaf wilt", no matter how long the leaf is set aside in the above apparatus only colorless (or, rarely, pale green) transparent drops of water, or nothing at all will emerge, thus confirming the diagnosis. This method can be used by farmers during grass removal operations employing a shaded ditch. It can be done in the field by taking mud from the bottom of a ditch, thrusting the leaf (cut according to the above directions) into it and covering. This method will not work with dead leaves, but with leaves which have at least some green coloration remaining in them.

6. Conclusion

Above we have explained the symptoms which are necessary for the early detection of the white leaf wilt of rice plants and described a simple procedure for diagnosis. However, if diseased leaves are detected early by this method (late July or early August) one may consider that the stocks (roots) of the rice plants throughout the paddy are heavily contaminated with disease bacteria, and if allowed to remain, movement of the bacteria and recontamination will take place via rains, flooding and thundershowers, the strength of the disease will increase and serious damage can easily occur. Especially the typhoons which come in the latter half of the rice harvesting season pose the danger of bringing in flood water and injury to the plants which will aid in spreading the disease. Consequently, in such a case, less fertilizer should be used and chemicals should be sprayed at the appropriate time. At the present time there is no chemical agent which has adequate strength against this disease, but if the disease is detected its spread can be considerably checked by spraying 3 parts of bordeaux solution per eight to [1 to = 15.88 ct] of lime, 10 me [one me = 3.759 grams] per to of ["copper mercury solution"] making one application (spraying) immediately and then two more from the period in which the shiyo ["stop leaves"] develop to the earing period, for total of three applications, or agricultural antibiotics, using a proportion of 8 to per tan [one tan = 0.245 acres] each time, in a 200 x solution if using 50,000 units.

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